

Comments on Michael (1993): Establishing Operations

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The present comments concern Michael's concept of motivative variables, and the implications of that concept for our understanding of the nature of reinforcement as well as the extinction of responses maintained through positive and negative reinforcement. We note that both extinction and altering motivative variables decrease responding, but they do so differently. The former does so by discontinuing the response-reinforcer relation. The latter does so by altering the motivation to respond. We emphasize that we shouldn't conclude we have extinguished a response just because we have performed some operation that results in decreased responding. The difference is especially important for an understanding of how we might reduce maladaptive avoidance responses, such as found in phobias or obsessive-compulsive disorders.

Key words: motivative operations, discriminative stimulus, positive reinforcement, negative reinforcement, extinction

As Hineline (1980, p. 72) put it, our language is our calculus. In light of this view, few things are more important than clarifying and refining the circumstances that occasion our explanatory concepts, so that we may better achieve prediction and control. Michael's (1993) article is exemplary in this regard.

The present comments concern Michael's concept of motivative variables, and the implications of that concept for our understanding of the nature of reinforcement as well as the extinction of responses maintained through positive and negative reinforcement. Additional review of these matters may be found in Moore (2008, chap. 6).

MOTIVATIVE AND DISCRIMINATIVE VARIABLES

According to Michael (1993), a motivative variable is an environmental event, operation, or stimulus condition that affects an organism by momentarily altering (a) the reinforcing effectiveness of other events, and (b) the frequency of occurrence of that part of the organism's repertoire relevant to those events as consequences. Subsequently, Michael (2003) spoke of the value-altering and behavior-altering effects of motivative variables. With respect to (a), when operations such as food deprivation increase the rein-

forcing effectiveness of food as the consequence of a response, he suggested we speak of a *reinforcer establishing effect*. When operations such as satiation decrease the reinforcing effectiveness of food as the consequence of a response, he suggested we speak of a *reinforcer abolishing effect*. With respect to (b), when the operations such as food deprivation increase the frequency of all behavior that was previously reinforced with food, he suggested we speak of an *evocative effect*. When the operations such as satiation decrease the frequency, he suggested we speak of an *abative effect*.

In contrast to motivative variables are discriminative variables. For Michael (1993), a discriminative stimulus is correlated with the differential availability of an effective form of reinforcement given a particular type of behavior. The notion of "differential availability" means that the relevant consequence has been in some way more available in the presence than in the absence of the stimulus condition or discriminative stimulus. In addition, the absence of the stimulus condition further means that the unavailable event would have been effective as reinforcement if it had been obtained, and the behaving organism has a history in which it has in fact made responses in the presence of the discriminative stimulus that have produced the reinforcer, and has made responses in the absence of the discriminative stimulus that have not.

Michael (1993) emphasized that for a hungry rat, the hunger is appropriately

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considered a motivative variable, rather than a discriminative variable. The reason is that in the absence of the food deprivation that causes the hunger, reinforcement via a food pellet is not relevant. That is, in the absence of the food deprivation, reinforcement is not being signaled as unavailable because the notion of reinforcement does not even apply. Similarly, in an escape procedure, shock is appropriately considered a motivative variable, rather than a discriminative variable, because in the absence of the shock, reinforcement via shock termination is not relevant. That is, in the absence of the shock, reinforcement is not being signaled as unavailable because the notion of reinforcement does not even apply.

POSITIVE REINFORCEMENT, NEGATIVE REINFORCEMENT, AND EXTINCTION

A proper analysis of motivative variables is of course vitally necessary to anyone who seeks a causal understanding of behavior. To illustrate the necessity, let us further consider the extinction of responses maintained through positive and negative reinforcement. We start with the positive reinforcement case.

Suppose that the lever presses of a hungry rat in a standard operant experimental chamber produce a food pellet. We note that under these conditions the rat learns to press the lever and will continue to do so. We now turn off the pellet dispenser. We note that the rat responds numerous times but eventually stops. We say we have extinguished the lever press. If we had satiated the rat prior to the experimental session instead of turning off the pellet dispenser, and the rat's responding decreased to a comparably low rate, we presumably would not say that we had extinguished the lever press. According to conventional usage, extinction involves bringing about a decrease in responding by discontinuing the response-reinforcer relation, not by altering motivation. Note that in the case above, we brought about a decrease in responding by discontinuing the response-reinforcer relation: We no longer presented the food pellet as a consequence of a response, although the rat was still deprived and the food pellet would have been effective

as a reinforcer if it was delivered as a consequence of a response.

A related question is what term to apply when we have brought about a decrease in responding in a second way, which also involves discontinuing the response-reinforcer relation. In this second way, we present food pellets independently of a response, but not so frequently as to alter motivation. According to Michael's definition of reinforcement and extinction, such a decrease would not appropriately be termed extinction, although so far as I know he did not invoke a different term. I suggest the term extinction would be useful, if only for the sake of parsimony.

We may now consider the negative reinforcement case. Suppose that lever presses of a rat in a standard operant experimental chamber cancel a brief shock that in the absence of a response would be delivered through the floor bars of its cage to its paws. As before, we note that under these conditions the rat learns to press the lever and continues to do so. Now suppose we turn off the shock generator. We note that the rat responds numerous times but eventually stops. Would it be appropriate to say that we have extinguished the avoidance response? After all, we have turned off a piece of apparatus that is concerned with the development of its responding, and its responding has decreased. Have we performed the same operation as turning off the pellet dispenser for a hungry rat, which we termed extinction of a response maintained through positive reinforcement?

I agree with Michael that it is not appropriate to say we have extinguished the response. The rationale for this answer, of course, is to be found in an understanding of motivative variables. In the case of positive reinforcement, the hungry rat remains motivated, such that a food pellet would be an effective reinforcer if was delivered as a consequence of a response, even though we have actually turned off the pellet dispenser or even though we have intermittently delivered food pellets independently of lever pressing. The response decreases in frequency because the relation between the response and its consequence has been discontinued, rather than because we have altered the motivation to respond.

Does a comparable state of affairs exist in the case of negative reinforcement, for the rat that has avoided shocks in the past but for which at present the shock generator is turned off? Let's analyze the situation. When we have turned off the shock generator, we have done the same thing as satiating the rat prior to the experimental session in which if the rat were hungry, lever presses would produce food pellets. If we turn off the shock generator, the rat would presumably stop responding, but the operation we have carried out has altered the motivation to respond, not the response-reinforcer relation. If we want to extinguish the avoidance response, we must discontinue the relation between the response and its consequence, but not alter the motivative operation. Michael has emphasized, and correctly so, that turning off the shock generator is behaviorally neutral, much like making food reinforcement unavailable for a food-satiated rat.

How then could we discontinue the relation between the response and its consequence, but leave the motivating operation in effect? Suppose the rat is performing on a Sidman avoidance procedure with $S - S = 5$ s and $R - S = 20$ s. We could extinguish the response by leaving the $S - S$ phase in force continuously, even if the animal does make a response. Here the rat remains motivated, for example, because avoiding the shock would be a reinforcer, but the response has no consequence with respect to that reinforcer. This case is analogous to turning off the food dispenser for a hungry rat.

A seemingly related question is what would be the effect of presenting the $R - S$ interval independently of a response, which is an operation that would appear to be analogous to the positive reinforcement case of presenting food pellets independently of a response to a hungry rat. The analogy is not exactly faithful, however, because of the technical difficulty in actually implementing the procedure. In the positive reinforcement case, food pellets would still be reinforcing for a hungry rat. In Sidman avoidance, failing to respond invokes a motivating condition in which shocks are presented. In addition, it is conceivable that by responding before the $R - S$ interval had elapsed the rat could avoid all shocks in an experimental session. How exactly would we implement presenting the

$R - S$ interval independently of a response? This question asks what would we do at the end of the $R - S$ interval? On one hand, we could arrange for the rat to spend the entire session in the $R - S$ phase, and for the rat to experience shocks every 20 s instead of every 5 s. On the other hand, we could simply not give the rat any shocks at all.

Presumably, both implementations would reduce responding. The first implementation is equivalent to leaving the $S - S$ interval in effect, albeit at a duration that was previously the $R - S$ interval. The second implementation alters the motivation to respond. It is analogous to turning off the shock generator, rather than to discontinuing the response-reinforcer relation. According to Michael's definition of reinforcement and extinction, only the first implementation would appropriately be termed extinction because it is the one that discontinues the response-reinforcer relation.

SUMMARY AND CONCLUSIONS

In any event, the point is that without recognizing the importance of motivative variables, we might mistakenly assume that we have extinguished an avoidance response if we turn off the shock generator and avoidance responding decreases. However, all we have really done is alter the motivation to respond. To extinguish a response, we need to directly discontinue the response-reinforcer relation, without altering motivation.

A clarification of these cases contributes to our understanding of the extinction of avoidance. For example, suppose our goal as therapists or clinicians is to reduce some form of troublesome avoidance behavior, such as found in phobias or obsessive-compulsive disorders. Presumably, we would need to identify whether we might do so by altering the motivative variables or by extinguishing the response. Altering the motivative variables might work in one sense, but one problem is that the troublesome behavior might return when the motivative variables are reinstated. We might call this state of affairs "recidivism." We may not have met the needs of our clients if we have decreased responding by decreasing the motivation to respond, rather than by discontinuing the response-reinforcer relation.

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